

COIN SEPARATOR AND SORTER ASSEMBLY

BACKGROUND OF THE INVENTION

The present invention relates to coin banks. More particularly, the present invention relates to a very accurate coin separating and sorting assembly for a coin bank, the assembly being able to sort all of a country's coins currently in widespread use. For the United States, such coins are the penny, nickel, dime, quarter and dollar coins.

Coin banks are generally known. A user places one or more coins in a hopper or similar coin receiving location. A coin separating mechanism separates the coins and moves them, hopefully one at a time, into a coin sorting mechanism. The coin sorting mechanism classifies the coins by their diameter. Coins of a particular diameter, and consequently of a particular denomination, are directed into the appropriate one of a plurality of sorted coin storage containers.

Coin separating mechanisms employing rotating coin separator plates are known. One known such separator plate is in the form of a disk having four U-shaped notches formed in its periphery. Each notch is sized to be larger in width than the largest coin which is to be sorted by the coin sorter. The separator plate is mounted on a planar base of a receiver, the base being fixed to an upper housing at a slope of approximately 45° from the horizontal. Coins tend to come to rest in the lowermost portion of the receiver with their faces contacting the separator plate or the base. When the separator plate is rotated, it will engage a coin with the edge of one of its notches and carry it upward to an opening formed in the base where the coin will fall through into an upper portion of a coin ramp leading to the sorting ramp. The ramp has apertures of increasing size through which the coins fall into sorted coin containers. The thickness of the sorter plate is chosen to be less than or equal to the thickness of the thinnest

coin to be sorted so that only one coin at a time is engaged by each notch. However, this known coin separating mechanism does not employ a separator plate which delivers pre-oriented coins to a sorter. Nor does it perform its separating and sorting functions in a minimum of space. Also this known coin separating mechanism is not designed to handle dollar coins.

Accordingly, it is desirable to develop a new and improved coin separator and sorter assembly which would overcome the foregoing deficiencies and others as well as providing better and more advantageous overall results.

BRIEF SUMMARY OF THE INVENTION

According to one aspect of the present invention, a coin bank is provided.

More particularly, in accordance with this aspect of the invention, the coin bank comprises a coin hopper, a coin slide positioned below the coin hopper and a coin separating and sorting assembly located between the coin hopper and the coin slide. The coin separating and sorting assembly comprises a separating wheel including at least one coin receiving aperture, with a toroidal flange extending away from a face of the coin separating wheel, and a wheel housing on which the separating wheel is supported. The wheel housing includes a toroidal channel in which the toroidal flange of the separating wheel is accommodated.

According to another aspect of the present invention, a coin separating and assorting assembly is provided.

More particularly, in accordance with this aspect of the invention, the assembly comprises a separating wheel including at least one coin receiving aperture and a wheel housing on which the separating wheel is supported. The wheel housing comprises at least one aperture which is sized to allow passage of a coin of a defined maximum diameter therethrough. A coin support surface is

provided on one of the separating wheel and the wheel housing. A coin rolling surface is defined on one of the separating wheel and the wheel housing.

5 In accordance with still another aspect of the present invention, a coin separating and sorting assembly is provided.

More particularly in accordance with this aspect of the present invention, the assembly comprises a separating wheel including at least one coin receiving aperture located in a wall of the separating wheel. A wheel housing is provided on which the separating wheel is supported. A coin support surface is provided on one of the separating wheel and the wheel housing for supporting a portion of an associated coin being moved by the separating wheel in relation to the wheel housing. A coin rolling surface is defined on one of the separating wheel and the wheel housing.

BRIEF DESCRIPTION OF THE DRAWINGS

The invention may take form in certain components and structures, several embodiments of which will be illustrated in the accompanying drawings and wherein:

Figure 1A is an exploded perspective view of a first portion of a coin bank according to a first embodiment of the present invention;

Figure 1B is an exploded perspective view of a second portion of the coin bank according to the first embodiment of the present invention;

Figure 1C is an exploded perspective view of a third portion of the coin bank according to the first embodiment of the present invention;

Figure 2 is an enlarged perspective view from a top side of a separating wheel of the coin bank of Figure 1;

Figure 3 is a perspective view from a bottom side of the separating wheel of Figure 2;

Figure 4 is an enlarged perspective view from a top side of a wheel housing of the coin bank of Figure 1;

Figure 5 is a top plan view of the wheel housing of
Figure 4;

Figure 6 is an assembled top plan view of a coin
separating and sorting assembly of the coin bank of
Figures 1A and 1B;

Figure 7 is a greatly enlarged side elevational view
in partial section of a portion of the separating wheel
of Figure 2 when an attempt is made to accommodate two of
the smallest diameter coins meant to be sorted in a
single aperture;

Figure 8 is a greatly enlarged side elevational view
in partial section of a portion of the separating wheel
of Figure 2 when a largest one of the coins meant to be
sorted is accommodated in an aperture;

Figure 9 is an enlarged top plan view of a coin
slide of the coin bank of Figure 1B;

Figure 10 is a cross-sectional view along line 10-10
of the coin separating and sorting assembly of Figure 6;

Figure 10A is an enlarged view of a portion of the
coin separating and sorting assembly of Figure 10;

Figure 11 is an enlarged cross-sectional view along
line 11-11 of the coin separating and sorting assembly of
Figure 6;

Figure 12 is a greatly enlarged partial bottom plan
view of the separating and sorting assembly of Figure 6
with parts removed for clarity;

Figure 13 is an enlarged cross-sectional view along
line 13-13 of the coin separating and sorting assembly of
Figure 6 with a coin being held therein;

Figure 14 is a cross-sectional view of a coin being
held in a coin separating and sorting assembly according
to a second embodiment of the present invention, wherein
the coin is of sufficient diameter so as to resist
falling through an aperture in a wheel housing;

Figure 15 is a cross-sectional view of the second
embodiment of the coin separating and sorting assembly in
accordance with Figure 14 but with a coin of a

sufficiently small diameter as to allow the coin to fall through the wheel housing aperture;

Figure 16 is a cross-sectional view of a coin separating and sorting assembly according to a third embodiment of the present invention;

Figure 17 is a partial top-plan view of a wheel housing according to a fourth embodiment of the present invention;

Figure 18 is a cross-sectional view of a fifth embodiment of the coin separating and sorting assembly in accordance with the present invention; and

Figure 19 is a partial top-plan view of a sorting wheel and a wheel housing according to a sixth embodiment of the present invention.

DETAILED DESCRIPTION OF THE SEVERAL EMBODIMENTS

Referring now to the drawings, wherein the showings are for purposes of illustrating several embodiments of the invention only and not for purposes of limiting same, the Figures show a coin separating and sorting assembly as employed in one type of coin bank. Of course, it should be appreciated that the coin separating and sorting assembly could be used in a variety of different coin banks.

With reference now to Figure 1B, the coin bank according to the present invention comprises a base 10 on which is positioned a ramp 12. The ramp is preferably secured to the base by suitable fasteners 13. Mounted on the base 10 is a back housing 14. Secured to the back housing is a switch 16 to which is connected an activation button 17. One or more batteries 18 can be mounted in a battery housing compartment 19 formed in the back housing 14. A coin overflow compartment 20 can be mounted on the base 10 via suitable fasteners 22.

With reference now also to Figure 1A, slidably mounted in the base 10 is a drawer 30. Housed in the drawer 30 is a coin tube base 32 having a rear support

wall 34 which is secured to the coin tube base 32 by suitable fasteners 35. Several coin tubes 36, one for each denomination of coins meant to be sorted, are selectively mounted on the coin tube base 32 and are supported by the support wall 34 which has suitably shaped indentations for that purpose. A front wall 40 of the apparatus is mounted to the back housing 14 by suitable fasteners 42 (Figure 1B). The front wall 40 is located above the drawer 30 and is spaced therefrom by the length of the coin tubes 36. A motor 44 of the apparatus has an output shaft (not visible in Figure 1A) connected to a gear train having a plurality of gears 46. The motor 44 and the gears 46 are mounted in a housing assembly having an upper housing portion 48 and a lower housing portion 50, which are secured together by a fastener 52.

Suitable fasteners 54 are employed to mount a wheel housing 60 in place in the apparatus. The motor housing halves 48 and 50 are secured by the fastener 52 to a lower face of the wheel housing 60. Mounted on the wheel housing 60 is a separating wheel 62. With reference again to Figure 1B, positioned beneath the wheel housing 60 and mounted thereto is a coin slide 64. A cover or hopper 66 is mounted above the wheel housing 60. A funnel 68 constitutes a top portion of the coin bank. The funnel is selectively removable from the coin bank to provide access to the separating wheel 62.

With reference now to Figure 2, the coin separating wheel 62 is toroidal or ring-like and includes a top wall 80 having a plurality of spaced apertures 82 located therein. Each of the apertures extends from an inner periphery of the ring-like sorting wheel 62 to an outer flange 84 thereof. Also provided is an inner flange 86 which depends from the inner periphery of the top wall 80. A set of slots 88 are located in the inner flange 86, each slot opening to a respective one of the apertures 82. The inner flange 86 surrounds an open

center portion 89 of the separating wheel. Each of the apertures 82 includes a leading edge 90 and a trailing edge 92. The trailing edge has a tapered surface 94, best illustrated in Figure 7. With reference now also to Figure 3, provided on an outer surface of the inner flange 86 is a set of gear teeth 96.

With reference now to Figure 8, each aperture 82 is sized so as to accommodate the largest diameter coin 102 meant to be sorted. If the coins are United States coins, the largest diameter coin meant to be sorted in the coin sorting apparatus is a Sacajawea or Susan B. Anthony dollar. It should also be apparent from Figure 8 that the thickness of the top wall 80 is greater than the thickness of the largest diameter coin 102. In United States coinage the largest diameter coin is also the thickest coin, the dollar coin.

The reason why the leading edge of each aperture 82 is thicker than the thickness of the thickest diameter coin being sorted is that it is undesirable if a coin held in the aperture 82 picks up another coin during sorting simply because a top surface of the coin extends out of the aperture. In other words, if the thickest coin being sorted were thicker than is the thickness of the top wall 80, such thicker coin could pick up another coin thereby causing a missorting as the coin would itself act as a picker element, which is meant to be function of the separating wheel.

With reference now to Figure 7, it is apparent that the trailing edge 92 of each aperture 82 is thinner than is the thickness of the thinnest coin 104 meant to be sorted. If the coin sorter is meant to sort United States currency, then that coin would be a dime. It should also be apparent from Figure 7 that the size of the aperture 82 is smaller than two such smallest diameter coins 104 positioned side by side. In other words, the apertures 82 will not accommodate two such coins 104 in a side by side manner. Rather, one of the

coins will project out of the aperture, as is illustrated in Figure 7.

It should be apparent from Figure 2 that the shape of the apertures 82 is asymmetrical. In other words, each aperture 82 is more curved at its leading edge 90 than it is at its trailing edge 92. The more circular leading edge insures that while the aperture is large enough to accommodate the largest diameter coin 102 meant to be sorted, it is not so large as to hold two of even the smallest diameter coins 104 meant to be sorted.

10 Also, the aperture is of suitable dimensions as to cause an inner portion of the largest diameter coin meant to be sorted to protrude through the slot 88, as best illustrated in Figure 6.

15 The coins are urged by gravity radially inwardly during rotation of the wheel due to the shape of the aperture 82 and the angle at which the separator wheel 62 is mounted before the coins reach the first aperture in the wheel housing. In other words, the angle at which the separator wheel 62 and wheel housing 60 are oriented in relation to a horizontal plane is large enough to overcome the force of friction and allow the coins to slide radially inwardly on the wheel housing. That angle may be approximately 45°. Configuration of the trailing edge 92 is important in allowing coins to move radially inwardly during rotation of the wheel before the coins reach the first wheel housing aperture.

20 The radially outermost point of each separator wheel aperture 82 is even with the outer flange 84 and no wall section is located between them. This construction prevents coins at the lowest point of the coin sorter during rotation of the wheel in relation to the wheel housing from getting hung up and not falling completely into an aperture 82. Such a wall section would prevent the coins from being successfully sorted.

25 With reference now to Figure 4, the wheel housing 60 comprises an outer wall 110 having an outer skirt 112.

Located radially inwardly from the skirt 112 are a series of spaced apertures 114. It is apparent that the apertures are of different sizes such that the apertures increase in width clockwise from a smallest width aperture 114a to a largest width aperture 114e.

Positioned radially inwardly from the set of apertures 114 is a channel shaped groove 116. It is apparent that the groove 116 is ring-like in nature. The groove 116 surrounds a central wall portion 118 of the wheel housing. Each of the apertures 114 can be defined by a tapered rear wall 120 as well as an outer edge 124 and an inner edge 126. It should be apparent from Figure 5 that while the inner edges 126 for each of the apertures 114 remain at the same radial distance from an axis of the wheel housing 60, the outer edges 124 of the apertures are at a progressively greater distance from the axis of the wheel housing, increasing in a clockwise manner. This allows the apertures to accommodate increasingly larger diameter coins from a smallest diameter coin meant to be sorted being accommodated in aperture 114a to a largest diameter coin meant to be sorted being accommodated in aperture 114e.

With reference now to Figure 10, it should be appreciated that the central wall portion 118 is a plateau 130 with a somewhat C-shaped recessed area 132. The purpose for the recessed area is to allow coins not fitting in an aperture 82 to slide down in the direction of arrow 134. The coins slide, due to gravity, toward a lower portion of the wheel housing 60. It should be apparent from Figure 10 that the central wall portion 118 is at a higher elevation than is the outer wall portion 110. Thus except for the recessed area 132, the plateau 130 of the central wall portion 118 lies at the same elevation as the top surface of the separating wheel 62 which is accommodated in the wheel housing 60. This can be seen from Figure 11. In contrast, the C-shaped recessed area 132 of the central wall portion 118 is at

the same elevation as the wheel housing in an area where there is an aperture 82 extending through the separating wheel 62. This can be seen from Figure 10A.

5 The difference in height between the central wall portion 118 and the outer wall 110 of the wheel housing defines a stationary rolling surface 136 against which an edge of a coin being sorted rolls as the coin is moved by the separating wheel 62 in a clockwise manner on the wheel housing until the coin falls through the aperture 10 114 designed to accommodate it. The rolling surface 136 has a width which is thinner than a thickness of the thinnest coin meant to be sorted.

15 As mentioned previously, the straighter trailing edge 92 of the separating wheel aperture 82 enables smaller coins, once they are picked up, to travel radially inwardly, i.e. centripetally, due to gravity so as to protrude through the slot 88 to the greatest extent possible. This enables the smaller coins to be sorted correctly. Forcing smaller coins to move centripetally establishes a relationship between a radially inner point of a coin, the sorting surface, namely the outer edge 124 of the aperture 114, and the stationary rolling surface 136.

20 25 With reference now to Figure 12, it can be seen that a slot 138 is located in the wheel housing 60. The slot enables a suitable one of the gears 46 to contact the gearing 96 of the separating wheel 62 in order to allow the separating wheel to be rotated when the separating wheel is mounted in the wheel housing 60. While gearing 30 35 96 is illustrated for the sorting wheel 60, it should be appreciated that the sorting wheel could also be rotated by other means, such as via a belt or a similar known arrangement.

With reference now to Figure 9, the coin slide 64 is provided with five coin sliding surfaces 140 - 148. Each of the coin sliding surfaces is positioned beneath a respective one of the openings 114a - 114e. The coin

slide slopes from an upper end 149 to a lower end 150. Positioned at a lower end of each of the coin sliding surfaces 140 - 148 is a respective opening 152a - 152e. It should be apparent that the several openings 152a - 152e are of differing diameters, with the aperture 152a having the smallest diameter and the aperture 152e having the largest diameter. The diameters of the apertures 152a - 152e are each slightly larger than the diameter of the coin meant to be accommodated in a respective one of the slides. The diameters of the apertures 152a - 152e correspond with the widths of the openings 114a - 114e in the wheel housing 60.

A pair of spaced ears 154 are located on the upper end 149 of the coin slide 64. These ears 154 cooperate with suitable ears 156 (Figure 4) extending away from the skirt 112 of the wheel housing 60. Similarly, spaced posts 157 extend away from the lower end 150 of the coin slide adjacent the smallest and largest diameter apertures 152a and 152e. The posts 157 cooperate with ears 158 (Figure 4) extending away from the skirt 112 of the wheel housing 60. Suitable fasteners, not illustrated, enable the coin slide 64 to be mounted beneath the wheel housing 60 via the cooperating ears 154 and 156 and the cooperating posts 157 and ears 158. Note that a center portion of the coin slide lower end 150 is somewhat recessed in relation to the two wings thereof to form a somewhat crescent shaped lower end 150. This shape allows the motor housing 48, 50 to be secured to the wheel housing while not interfering with the coin slide 64.

With reference now to Figure 13, a coin 172 is shown being positioned in an aperture 82 of the sorting wheel 62. The coin abuts the rolling surface 136 of the wheel housing 60. The coin is supported along its radially inner portion by the flange 86 of the sorting wheel. However, the coin cannot fall through the aperture 114 because it has a diameter larger than the diameter of the

aperture.

The separating wheel 62 and the wheel housing 60, as well as the coin slide 64, can be manufactured from a suitable conventional plastic material. Alternatively, they can be made of a suitable conventional metal.

The operation of the coin sorter according to the present invention is as follows. As coins are dropped into the funnel 68, they will fall through an aperture 160 at the center thereof and fall into the hopper 66 and onto the sorting wheel 62. As the motor 44 rotates the gears 46 in the gear train, the gears will engage the gearing 96 on the separating wheel 62 causing it to begin rotating in a clockwise direction. The coins thus being held in the cover or hopper 66 are moved and fall into respective ones of the apertures 82 in the separating wheel 62. As the wheel 60 rotates on the canted wheel housing 62, coins will slide radially inwardly in the apertures 82, due to gravity as a result of the angle at which the coin separator wheel is positioned in relation to a vertical axis, and contact the rolling surface 136. The coins will roll against this surface as the wheel 62 rotates and moves the coins over the wheel housing 60. As a coin held in an aperture 82 of the wheel travels over the several increasingly larger sized apertures 114a - 114e in the wheel housing 60, the coin will fall through the correctly sized opening. The coin will fall into the associated one of the coin sliding surfaces 140 - 148. The coin will then travel down the slide and fall through the associated one of the apertures 152a - 152e. Coins will thereafter fall into a respective one of the coin containers 36 and be stacked therein.

While the wheel housing 60 and separating wheel 62 are illustrated as being used in connection with a coin slide 64 and a coin sorter mechanism as shown in Figures 1A and 1B, it should be appreciated that the wheel housing and sorting wheel disclosed herein can be used in a large variety of other types of coin sorters having

much different types of coin slides and coin receiving areas, not to mention means for storing the coins or dispensing the coins as may be required.

With reference now to Figure 14, according to another embodiment, there is provided a wheel housing 180 and a sorting wheel 182. At least one aperture 184 is provided in the sorting wheel 182. In this embodiment, a gear surface 186 is defined in an outer surface of a flange 188 of the separating wheel 182. Provided in the wheel housing 180, is at least one aperture 190. The wheel housing 180 has an outer rim 192 and an inner portion 194. Located in the inner portion is a coin rolling surface 196 and a coin support surface 198. As shown in Figure 14, a relatively large diameter coin 202 is held in the aperture 184 of the separating wheel 182. The coin has a sufficiently large diameter that it cannot fall through the aperture 190 in the wheel housing 180.

In contrast, in Figure 15, a coin 204 is illustrated which is of a sufficiently smaller diameter that it can fall through the aperture 190. More specifically, the diameter d_1 of the coin 204 is smaller than the diameter d_2 of the coin 202. The distance between an inner surface 206 of the outer rim 192 and the coin rolling surface 196 of the wheel housing, defined as d_3 , can be less than d_1 and d_2 .

It should be apparent that a set of apertures is provided in both the separating wheel 182 and the wheel housing 180. The apertures 184 in the separating wheel 182 are all of the same size, whereas the apertures 190 in the wheel housing 180 are of progressively increasing width, as in the earlier embodiment. In all other respects, the second embodiment illustrated in Figures 14 and 15 is similar to the first embodiment illustrated in the earlier figures.

With reference now to Figure 16, a third embodiment of the invention is there illustrated. In this embodiment, there is provided a wheel housing 210 and a

separating wheel 212. Provided in the separating wheel is at least one aperture 214 which is located radially inwardly from a flange 218. Located in the wheel housing 210 is a set of apertures 220. The wheel housing 5 includes an outer rim 222 and an inner portion 224 on which is defined a coin rolling surface 226. A coin 232 is held in the separating wheel aperture 214 and is supported by an inner toroidal flange 234 of the separating wheel 212. It should be apparent that in this 10 embodiment, the coin support surface is part of the separating wheel 212, unlike the embodiment of Figures 14 and 15 where the coin support surface was part of the wheel housing.

15 The wheel housing and the separating wheel can be made of a suitable conventional thermoplastic material (as shown in the embodiment of Figures 14 and 15) or out of a suitable conventional metal (as shown in the embodiment of Figure 16).

20 With reference now to Figure 17, a fourth embodiment of the present invention includes a wheel housing 240 in which is provided an elongated opening 242 having a staggered set of widths. More particularly, the opening has a first width section 244, a second width section 246, a third width section 248, a fourth width section 250, and a fifth width section 252. Each of these 25 sections will accommodate a particular diameter of a coin. Just as with the embodiment of Figure 4, five different diameter coins can be sorted as they are moved by a rotating separating wheel (not shown) in relation to the stationary wheel housing 240. The smallest diameter coin will fall through the first section 244 of the elongated opening 242, whereas the largest diameter coin will fall through the fifth section 252 thereof. Thus, it should be appreciated that bridges separating the 30 various coin sorting apertures, such as illustrated in Figure 4, are not necessary for the correct functioning of the coin separating and sorting assembly according to

the present invention.

With reference now to Figure 18, a fifth embodiment of the present invention includes a wheel housing 260 on which is mounted a separating wheel 262. The separating wheel is provided with at least one aperture 264.

Depending from a lower surface of the wheel 262 is a stem 266 around which is looped a suitable conventional belt 268 to allow the wheel 262 to be rotated. Located in the wheel housing 260 is a set of apertures 270. The wheel housing includes an outer portion 272 which is positioned radially outwardly of the apertures 270 and a radially inner portion 274. The wheel housing also includes a flange 276 extending away from the wheel housing outer portion 272. In this embodiment, a coin rolling surface 278 is provided by an inner periphery of the aperture 264 of the separating wheel 262. A coin support surface is provided by the wheel housing inner portion 274. It should also be noted that in this embodiment, the separating wheel has an outer portion 280 which is located radially outwardly of the at least one aperture 264. As in the previous embodiments, when a coin 282 encounters a wheel housing aperture 270 of suitable size, it will fall through the aperture.

With reference now also to Figure 19, in a sixth embodiment of the present invention a wheel housing 290 supports a separating wheel 292. The separating wheel includes at least two apertures 294. Unlike the embodiment of Figure 18, the separating wheel apertures extend all the way to an outer periphery 296 of the wheel such that a gap 298 is defined at the intersection of the aperture 294 and the outer periphery 296. The wheel housing has at least one aperture 300 extending therethrough to allow passage of a coin of a desired diameter therethrough. In this embodiment, a coin support surface 302 is provided by an inner portion of the wheel housing 290 whereas a coin rolling surface 304 is provided by a radially inner wall of the wheel 292.

The invention has been described with reference to several embodiments. Obviously, modifications and alterations will occur to others upon a reading and understanding of the preceding specification. It is intended that the invention be construed as including all such modifications and alterations insofar as they come within the scope of the appended claims and the equivalents thereof.

5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20
21
22
23
24
25
26
27
28
29
30
31
32
33
34
35
36
37
38
39
40
41
42
43
44
45
46
47
48
49
50
51
52
53
54
55
56
57
58
59
60
61
62
63
64
65
66
67
68
69
70
71
72
73
74
75
76
77
78
79
80
81
82
83
84
85
86
87
88
89
90
91
92
93
94
95
96
97
98
99
100
101
102
103
104
105
106
107
108
109
110
111
112
113
114
115
116
117
118
119
120
121
122
123
124
125
126
127
128
129
130
131
132
133
134
135
136
137
138
139
140
141
142
143
144
145
146
147
148
149
150
151
152
153
154
155
156
157
158
159
160
161
162
163
164
165
166
167
168
169
170
171
172
173
174
175
176
177
178
179
180
181
182
183
184
185
186
187
188
189
190
191
192
193
194
195
196
197
198
199
200
201
202
203
204
205
206
207
208
209
210
211
212
213
214
215
216
217
218
219
220
221
222
223
224
225
226
227
228
229
230
231
232
233
234
235
236
237
238
239
240
241
242
243
244
245
246
247
248
249
250
251
252
253
254
255
256
257
258
259
259
260
261
262
263
264
265
266
267
268
269
269
270
271
272
273
274
275
276
277
278
279
279
280
281
282
283
284
285
286
287
288
289
289
290
291
292
293
294
295
296
297
298
299
299
300
301
302
303
304
305
306
307
308
309
309
310
311
312
313
314
315
316
317
318
319
319
320
321
322
323
324
325
326
327
328
329
329
330
331
332
333
334
335
336
337
338
339
339
340
341
342
343
344
345
346
347
348
349
349
350
351
352
353
354
355
356
357
358
359
359
360
361
362
363
364
365
366
367
368
369
369
370
371
372
373
374
375
376
377
378
379
379
380
381
382
383
384
385
386
387
388
389
389
390
391
392
393
394
395
396
397
398
399
399
400
401
402
403
404
405
406
407
408
409
409
410
411
412
413
414
415
416
417
418
419
419
420
421
422
423
424
425
426
427
428
429
429
430
431
432
433
434
435
436
437
438
439
439
440
441
442
443
444
445
446
447
448
449
449
450
451
452
453
454
455
456
457
458
459
459
460
461
462
463
464
465
466
467
468
469
469
470
471
472
473
474
475
476
477
478
479
479
480
481
482
483
484
485
486
487
488
489
489
490
491
492
493
494
495
496
497
498
499
499
500
501
502
503
504
505
506
507
508
509
509
510
511
512
513
514
515
516
517
518
519
519
520
521
522
523
524
525
526
527
528
529
529
530
531
532
533
534
535
536
537
538
539
539
540
541
542
543
544
545
546
547
548
549
549
550
551
552
553
554
555
556
557
558
559
559
560
561
562
563
564
565
566
567
568
569
569
570
571
572
573
574
575
576
577
578
579
579
580
581
582
583
584
585
586
587
588
589
589
590
591
592
593
594
595
596
597
598
599
599
600
601
602
603
604
605
606
607
608
609
609
610
611
612
613
614
615
616
617
618
619
619
620
621
622
623
624
625
626
627
628
629
629
630
631
632
633
634
635
636
637
638
639
639
640
641
642
643
644
645
646
647
648
649
649
650
651
652
653
654
655
656
657
658
659
659
660
661
662
663
664
665
666
667
668
669
669
670
671
672
673
674
675
676
677
678
679
679
680
681
682
683
684
685
686
687
688
689
689
690
691
692
693
694
695
696
697
698
698
699
699
700
701
702
703
704
705
706
707
708
709
709
710
711
712
713
714
715
716
717
718
719
719
720
721
722
723
724
725
726
727
728
729
729
730
731
732
733
734
735
736
737
738
739
739
740
741
742
743
744
745
746
747
748
749
749
750
751
752
753
754
755
756
757
758
759
759
760
761
762
763
764
765
766
767
768
769
769
770
771
772
773
774
775
776
777
778
779
779
780
781
782
783
784
785
786
787
788
789
789
790
791
792
793
794
795
796
797
798
798
799
799
800
801
802
803
804
805
806
807
808
809
809
810
811
812
813
814
815
816
817
818
819
819
820
821
822
823
824
825
826
827
828
829
829
830
831
832
833
834
835
836
837
838
839
839
840
841
842
843
844
845
846
847
848
849
849
850
851
852
853
854
855
856
857
858
859
859
860
861
862
863
864
865
866
867
868
869
869
870
871
872
873
874
875
876
877
878
879
879
880
881
882
883
884
885
886
887
888
889
889
890
891
892
893
894
895
896
897
898
898
899
899
900
901
902
903
904
905
906
907
908
909
909
910
911
912
913
914
915
916
917
918
919
919
920
921
922
923
924
925
926
927
928
929
929
930
931
932
933
934
935
936
937
938
939
939
940
941
942
943
944
945
946
947
948
949
949
950
951
952
953
954
955
956
957
958
959
959
960
961
962
963
964
965
966
967
968
969
969
970
971
972
973
974
975
976
977
978
979
979
980
981
982
983
984
985
986
987
988
989
989
990
991
992
993
994
995
996
997
998
998
999
999
1000